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EESS Wideband Briefing

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WHO IS NTIA?

NTIA serves as the principal adviser to the President on telecommunications policies as they pertain to the Nation's technological and economic advancement. NTIA is the primary Executive Branch agency responsible for developing and articulating domestic and international telecommunications policies. **NTIA also manages use of the radio frequency spectrum by all federal agencies.**

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EARTH EXPLORATION-SATELLITE SERVICE (EESS)

- *Earth exploration-satellite service:* A *radiocommunication service* between *earth stations* and one or more *space stations*, which may include links between *space stations*, in which:

  – information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from *active sensors* or *passive sensors* on Earth *satellites*;

  – similar information is collected from airborne or Earth-based platforms;

  – such information may be distributed to earth stations within the system concerned;

  – platform interrogation may be included.

  This service may also include *feeder links* necessary for its operation.

METEOROLOGICAL-SATELLITE SERVICE

- An *earth exploration-satellite service* for meteorological purposes.

SAMPLE BANDS OF METSAT ALLOCATIONS (COMMMUNICATIONS)

- 137-138 MHZ
- 401-403 MHZ
- 460-470 MHZ
- 1670-1710 MHZ
- 2025-2110 MHZ
- 2200-2290 MHZ
- 7750-7850 MHZ
- 18100-18300 MHZ

EESS (PASSIVE AND ACTIVE)

- active sensor: A measuring instrument in the earth exploration-satellite service or in the space research service by means of which information is obtained by transmission and reception of radio waves.
- passive sensor: A measuring instrument in the earth exploration-satellite service or in the space research service by means of which information is obtained by reception of radio waves of natural origin.

TWO EESS BANDS OF MAJOR INTEREST FOR SPACE-TO-EARTH COMMUNICATIONS :

8025-8400 MHZ

25500-27000 MHZ

8025-8400 MHZ

8025-8400 MHz				
International Table			United States Table	
Region 1	Region 2	Region 3	Federal Government	Non-Federal Government
8025-8175 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A			8025-8175 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) Mobile-satellite (Earth-to-space) (no airborne transmissions) US258 G117	8025-8175 US258
8175-8215 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A			8175-8215 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Mobile-satellite (Earth-to-space) (no airborne transmissions) US258 G104 G117	8175-8215
8215-8400 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A			8215-8400 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) Mobile-satellite (Earth-to-space) (no airborne transmissions) US258 G117	8215-8400 US258

5.462A In Regions 1 and 3 (except for Japan), in the band 8025-8400 MHz, the earth exploration-satellite service using geostationary satellites shall not produce a power flux-density in excess of the following provisional values for angles of arrival (θ), without the consent of the affected administration:

–174 dB(W/m²) in a 4 kHz band	for 0	$\leq \theta < 5°$
–174 + 0.5 (θ – 5) dB(W/m²) in a 4 kHz band	for 5	$\leq \theta < 25°$
–164 dB(W/m2) in a 4 kHz band	for 25	$\leq \theta \leq 90°$

These values are subject to study under Resolution 124 (WRC-97)*.

* Note by the Secretariat: This Resolution was revised by WRC-2000.

RESOLUTION 124 (Rev.WRC-2000)

Protection of the fixed service in the frequency band 8 025-8 400 MHz sharing with geostationary-satellite systems of the Earth exploration-satellite service (space-to-Earth)

Excerpt:

resolves

to invite a future competent world radiocommunication conference to review No. **5.462A**, taking into account Recommendation ITU-R F.1502, and to take appropriate action.

USA FOOTNOTES

US258 - In the bands 8025-8400 MHz and 25.5-27 GHz, the Earth exploration-satellite service (space-to-Earth) is allocated on a primary basis for non-Federal use. Authorizations are subject to a case-by-case electromagnetic compatibility analysis.

G117 - In the bands 7.25-7.75 GHz, 7.9-8.4 GHz, 17.8-21.2 GHz, 30-31 GHz, 33-36 GHz, 39.5-41 GHz, 43.5-45.5 GHz and 50.4-51.4 GHz, the Federal fixed-satellite and mobile-satellite services are limited to military systems.

PFD LIMITS AT 8025-8400 MHZ

AT SURFACE OF THE EARTH ; TABLE **21-4** (WRC-2000)

Frequency band	**Service***	**Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	
8 025-8 500 MHz	Earth exploration-satellite (space-to-Earth) Space research (space-to-Earth)	–150	–150 + 0.5(δ – 5)	–140	4 kHz

22.5 § 4 In the frequency band 8 025-8 400 MHz, which the Earth exploration-satellite service using non-geostationary satellites shares with the fixed-satellite service (Earth-to-space) or the meteorological-satellite service (Earth-to-space), the maximum power flux-density produced at the geostationary-satellite orbit by any Earth exploration-satellite service space station shall not exceed –174 dB(W/m^2) in any 4 kHz band.

EESS (8025-8400 MHz) & SRS Deep Space (8400-8450 MHz)

- Unwanted emissions from Earth Exploration-Satellite Servive (EESS) (space-to-Earth) transmitters into the adjacent SRS deep space band (8400-8450 MHz) should be controlled per the guidelines established in Recommendation ITU-R SA.1157

SHARING SCENARIOS WITH EESS, 8025-8400 MHZ

EESS SPACE STATION-TO-TERRESTRIAL: PFD

NGSO EESS SPACE STATION-TO-FSS/MSS/METSAT GSO SPACE STATION: PFD

GSO EESS SPACE STATION-TO-FSS/MSS/METSAT/EESS GSO SPACE STATION: FCOOR[1]

NGSO EESS SPACE STATION-TO-FSS/MSS/METSAT NGSO SPACE STATION: ICOOR[2]

EESS NETWORK-TO-EESS NETWORK: ICOOR[2] (EXCEPT GSO-TO-GSO)

TERRESTRIAL-TO-EESS EARTH STATION: FCOOR[1]
FSS/MSS/METSAT EARTH STATION-TO-EESS EARTH STATION: FCOOR[1]

EESS SPACE STATION-TO-SRS (8400-8450 MHZ; DEEP SPACE): ICOOR[2]

[1] - FCOOR = FORMAL COORDINATION
[2] – ICOOR = INFORMAL COORDINATION

25.5 – 27 GHZ

ALLOCATION TABLE
(INTERNATIONAL & USA)

23.6-30 GHz (SHF)					Page 5
International Table			United States Table		FCC Rule Part(s)
Region 1 Table	Region 2 Table	Region 3 Table	Federal Table	Non-Federal Table	
25.25-25.5 FIXED INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)			25.25-25.5 FIXED INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	25.25-25.5 Inter-satellite 5.536 Standard frequency and time signal-satellite (Earth-to-space)	Satellite Communications (25)
25.5-27 EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A			25.5-27 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) Standard frequency and time signal-satellite (Earth-to-space) 5.536A US258	25.5-27 Inter-satellite 5.536 Standard frequency and time signal-satellite (Earth-to-space) 5.536A US258	
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	27-27.5 FIXED FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE		27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	27-27.5 Inter-satellite 5.536	

5.536A Administrations operating earth stations in the Earth exploration-satellite service or the space research service shall not claim protection from stations in the fixed and mobile services operated by other administrations. In addition, earth stations in the Earth exploration-satellite service or in the space research service should be operated taking into account Recommendations ITU-R SA.1278 and ITU-R SA.1625, respectively. (WRC-03)

5.536B In Germany, Saudi Arabia, Austria, Belgium, Brazil, Bulgaria, China, Korea (Rep. of), Denmark, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Hungary, India, Iran (Islamic Republic of), Ireland, Israel, Italy, Jordan, Kenya, Kuwait, Lebanon, Libya, Liechtenstein, Lithuania, Moldova, Norway, Oman, Uganda, Pakistan, the Philippines, Poland, Portugal, Syria, Slovakia, the Czech Rep., Romania, the United Kingdom, Singapore, Sweden, Switzerland, Tanzania, Turkey, Viet Nam and Zimbabwe, earth stations operating in the Earth exploration-satellite service in the band 25.5-27 GHz shall not claim protection from, or constrain the use and deployment of, stations of the fixed and mobile services.

5.536 Use of the 25.25-27.5 GHz band by the inter-satellite service is limited to space research and Earth exploration-satellite applications, and also transmissions of data originating from industrial and medical activities in space.

5.536C In Algeria, Saudi Arabia, Bahrain, Botswana, Brazil, Cameroon, Comoros, Cuba, Djibouti, Egypt, United Arab Emirates, Estonia, Finland, Iran (Islamic Republic of), Israel, Jordan, Kenya, Kuwait, Lithuania, Malaysia, Morocco, Nigeria, Oman, Qatar, Syrian Arab Republic, Somalia, Sudan, Tanzania, Tunisia, Uruguay, Zambia and Zimbabwe, earth stations operating in the space research service in the band 25.5-27 GHz shall not claim protection from, or constrain the use and deployment of, stations of the fixed and mobile services. (WRC-03)

USA FOOTNOTE
(EESS AT 25.5-27 GHZ ADDED IN MARCH 2005)

US258 - In the bands 8025-8400 MHz and 25.5-27 GHz, the Earth exploration-satellite service (space-to-Earth) is allocated on a primary basis for non-Federal use. Authorizations are subject to a case-by-case electromagnetic compatibility analysis.

PFD LIMITS

AT THE SURFACE OF THE EARTH

TABLE **21-4** (WRC-03)

19.3-19.7 GHz 22.55-23.55 GHz 24.45-24.75 GHz 25.25-27.5 GHz	Fixed-satellite (space-to-Earth) Earth exploration-satellite (space-to-Earth) Inter-satellite Space research (space-to-Earth)	–115	$-115 + 0.5(\delta - 5)$	–105	1 MHz

- ITU-R SA.1278 (Feasibility of sharing between the Earth exploration-satellite service (space-to-Earth) and the fixed, inter-satellite, and mobile services in the band 25.5-27.0 GHz): i) PFD at the geostationary orbit from the EESS low Earth-orbiting user spacecraft will be limited to the values indicated in order to protect GSO Inter-Satellite Service reception; and ii) PFD limits at the surface of the Earth.

RECOMMENDATION ITU-R SA.1278

FEASIBILITY OF SHARING BETWEEN THE EARTH EXPLORATION-SATELLITE SERVICE (SPACE-TO-EARTH) AND THE FIXED, INTER-SATELLITE, AND MOBILE SERVICES IN THE BAND 25.5-27.0 GHz

recommends

1 that sharing between transmitting EESS satellites and receiving data relay satellites (DRS) operating in the ISS near 26 GHz is feasible given the following constraints:

– EESS satellites in sun-synchronous orbit or in an orbit that is proximate to the orbits of the DRS user satellites shall not produce a power-flux-density (pfd) greater than –155 dB(W/m^2) in 1 MHz at any location on the geostationary orbit (GSO) for more than 0.1% of the time (see Note 1);

– EESS satellites in orbits other than that mentioned above shall not produce a pfd greater than –155 dB(W/m^2) in 1 MHz at any location on the GSO for more than 1% of the time;

2 that, when designing EESS systems, the probability of receiving brief periods of interference from DRS user satellites in the ISS should be taken into account. This interference should exist for less than 0.1% of the time;

3 that EESS systems be designed to operate within the currently applicable pfd limits in the band:

Limit (dB(W/m^2)) in 1 MHz bandwidth for angle of arrival, φ, above the horizontal plane		
0° - 5°	5° - 25°	25° - 90°
–115	$-115 + 0.5(\varphi - 5)$	–105

4 that separation distances required between EESS receiving earth stations and the fixed and mobile transmitting stations may be derived using the methodology outlined in Annex 1 and the interference criterion for space-to-Earth EESS links contained in Recommendation ITU-R SA.1026 (separation distance refers to the distance that could be achieved in coordination);

5 that suitable measures related to the deployment of EESS earth stations may need to be identified in order not to constrain the use of the band 25.5-27.0 GHz by the FS.

NOTE 1 – Proximate orbits are defined as two circular orbits whose difference in altitude is smaller than 500 m and difference in orbital plane angle is smaller than 1.5°.

SHARING SCENARIOS WITH EESS, 25500-27000 MHZ

EESS SPACE STATION-TO-TERRESTRIAL: PFD

GSO EESS NETWORK-TO-EESS/ISS/SRS GSO NETWORK: FCOOR[1]

NGSO EESS NETWORK-TO-EESS/ISS/SRS GSO/NGSO NETWORK: IFOR[2]

TERRESTRIAL-TO-EESS EARTH STATION: FCOOR[1]

[1] - FCOOR = FORMAL COORDINATION
[2] – ICOOR = INFORMAL COORDINATION

EMC ISSUES:

EESS SHOULD:

1. MEET ALL PFD LIMITS
2. BEST ANTENNA PRACTICES, E.G., LARGER THE BETTER
3. MINIMIZE BANDWIDTH
4. OUT-OF-BAND FILTERING
5. MINIMUM NUMBER OF EARTH STATIONS
6. EARTH STATION LOCATION SELECTION
7. COORDINATE
8. REALIZE WHO YOU ARE SHARING THE BAND WITH AND THEIR REQUIREMENTS

CONCLUSIONS

- START YOUR WORK EARLY
- MAKE SURE YOU KNOW THE REGULATIONS AND RULES EARLY
- CONTACT THE NECESSARY PEOPLE